WOODWORK FOR SCHOOLS

ON SCIENTIFIC LINES

A COURSE FOR CLASS WORK OR PRIVATE STUDY

BY JAMES THOMAS BAILY

ORGANIZER OF MANUAL TRAINING, ROCHESTER, CHATHAM, AND GILLINGHAM HIGHER EDUCATION COMMITTEE

AND

S. POLLITT, B.Sc.

HEAD MASTER, SOUTHALL COUNTY SCHOOL, MIDDLESEX

PART III.

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PART III

The authors are indebted to the MANUAL TRAINING MAGAZINE *of America for the suggestion of models* 42*a*, 48*a*, *and* 56*a*.

WOODWORK FOR SCHOOLS

PART III

LESSON 41.

MITRED PICTURE-FRAME.

DRAWING.—You may bring a picture or a piece of mirror-plate to be framed.

Design a section of moulding, and project from

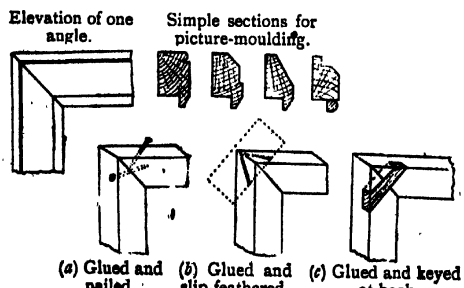


FIG. 79.—MITRED PICTURE-FRAME.

Oblique views of alternative jointing.

your section the elevation of the frame. The sections given are merely suggestive.

Benchwork. — Prepare the moulding, mitre together, and secure with glue and nails, or by the insertion of a piece of veneer in a saw-kerf in the angle.

Heavier frames may be keyed at the back, as shown by *c* in Fig. 79.

QUESTIONS.

1. Show a vertical section through the centre of a gluepot.
2. Why should the inner vessel have its lower part in water?

LESSON 41a.

PHOTOGRAPHIC PRINTING-FRAME.

Drawing. — Prepare working drawings or sketches of the Frame, making freehand sketches of the jointing.

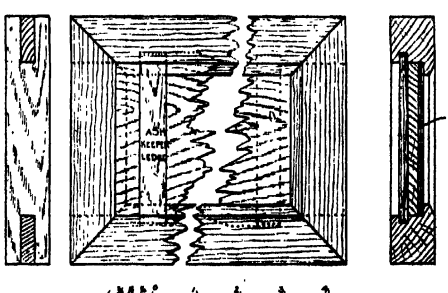


FIG. 80.—PHOTOGRAPHIC PRINTING-FRAME.

Benchwork.—The Frame is to be mitred, mortised, and tenoned together, rebated and chamfered, and mortises prepared for the keeper ledges; the

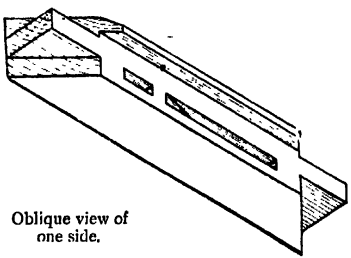


FIG. 81.—PHOTOGRAPHIC PRINTING-FRAME.

latter are to be rounded on the side adjacent to the back piece, so as to act like springs.

Wood suggested: mahogany for frame, any kind of wood for back, and ash for keeper ledges.

LESSON 42.

DROP-LEAF BRACKET.

Drawing.—From the plain model views draw and design a Drop-Leaf Bracket.

The maximum sizes are to be as follows:

Length, 2′ 6″; height, 3′ 6″; projection from wall, 1′ 8″.

Benchwork.—The two pieces forming the back are to be mortised and tenoned together.

The horizontal part of the back is screwed to the fixed part of the top; to the latter the remaining portion of the shelf is hinged.

The cantilever piece is tenoned into the back and draw-bore pinned, with a bracket underneath.

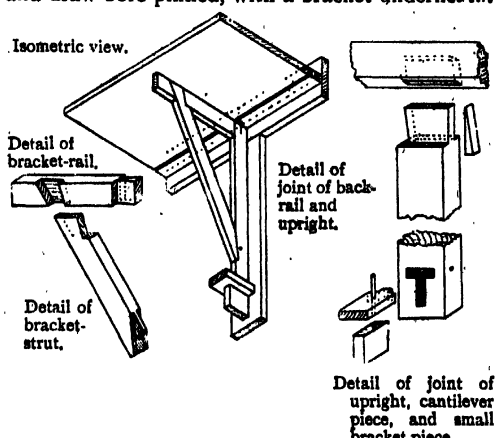


FIG. 82.—DROP-LEAF BRACKET.

The pivoted bracket is framed, the joint at the right angle being dovetail tenoned. The upper end of the compression bar is dovetail halved, and the lower end tenoned, notched, and pinned.

QUESTIONS.

1. What is brass?
2. How can it be softened for easier working, and how hardened again?

LESSON 42a.

HYGROSCOPE.

The Hygroscope serves as a weather indicator, in so far as it responds to the humidity of the atmosphere. The violin string absorbs moisture from the air and untwists, thus causing the man to come out. When the air becomes dry, the string twists tighter, thus causing the woman to come

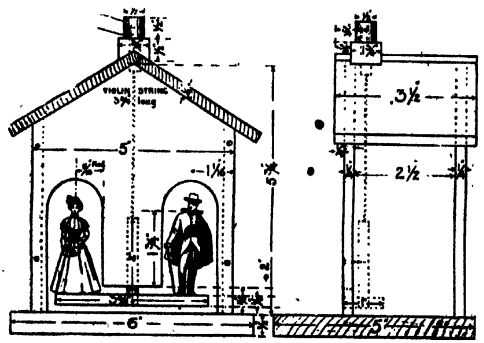


FIG. 83.—HYGROSCOPE.

out. The Hygroscope should be placed out of doors, but not exposed to rain or sunshine.

Drawing. — Prepare the necessary working drawings.

Benchwork.—Nail the back to the sides and screw on the front; fit and fix the roof, nailing into the sides and back only.

Nail the bottom on, and fix the chimney. Fix

the dowels, one into the chimney, the other into the platform, and secure the violin string by means of glue and wedges into the ends of the dowels.

The figures may be modelled in cardboard, clay, or wood; or they may be cast in plaster of Paris.

LESSON 43.

COMMON ANGLE DOVETAIL JOINT APPLIED TO CORNER BRACKET.

Drawing.—Prepare working drawings of a corner bracket; the angle of the two bracket pieces is to be jointed as shown in isometric.

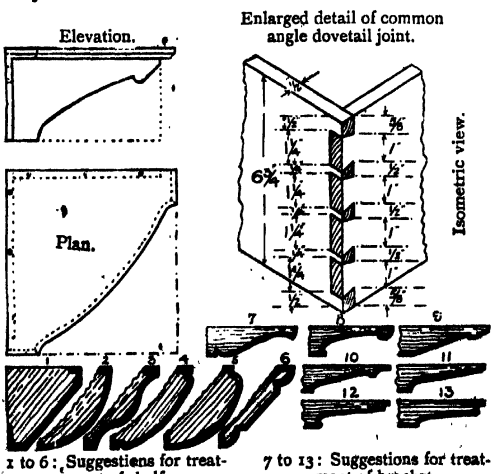


FIG. 84.—CORNER BRACKET.

Draw orthographic views of the joint shown in Fig. 84.

Various forms for the treatment of the shelf and bracket pieces are shown; you may adopt or modify any of these as you think best.

Benchwork.—The bracket pieces are to be dovetailed together and glued; the shelf and bracket pieces to be screwed together.

QUESTIONS.

1. Classify the following timbers under the headings of (*a*) Conifers and (*b*) Leafy Timber Trees:

Virginian Red Cedar, Beech, Ash, Yellow Deal, Spruce Fir, Oak, Yellow Pine, Elm, Teak, Walnut, Larch, Whitewood, and Mahogany.

2. Make a list of the above-named timbers in the order of their hardness.

LESSON 43a.

AN UNDERSHOT WATER-WHEEL.

An Undershot Water-Wheel is turned by the water passing beneath.

An elevation and plan are shown in Fig. 85, the paddles being radially arranged.

A and B (Fig. 86) are alternative methods of shaping the float-boards or paddles.

Fig. 86 is a section of a wheel showing the paddles arranged at 30° to the radii. The mill-race is to be confined in the troughs shown.

Drawing.—Prepare working drawings of an Undershot Water-Wheel. You may please yourself

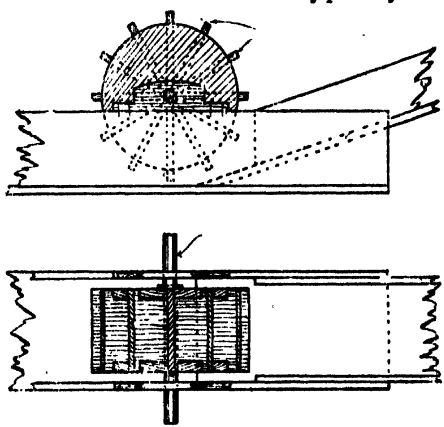


FIG. 85.—UNDERSHOT WATER-WHEEL.

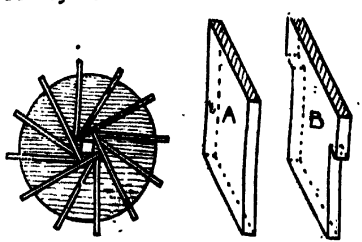


FIG. 86.—UNDERSHOT WATER-WHEEL.

as to the dimensions of the parts, and also as to the shape and arrangement of the paddles.

You may add some construction to contain the water at the head, and to receive it at the end of the trough.

Benchwork.—Make the Water-Wheel as shown by your drawings.

LESSON 43b.

MOTH-TRAP AND MOUNTING-BOARDS.

Drawing.—Prepare working sketches of the Moth-Trap and Mounting-Boards to sizes most suited to your purpose.

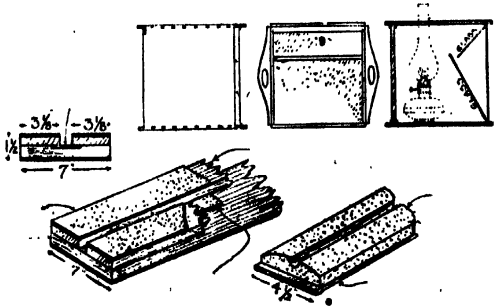


FIG. 87.—MOTH-TRAP AND MOUNTING-BOARDS.

Benchwork.—Make the Moth-Trap in accordance with your sketches.

The two pieces of glass may lie in grooves in

the two sides, or between small beads bradded to the sides.

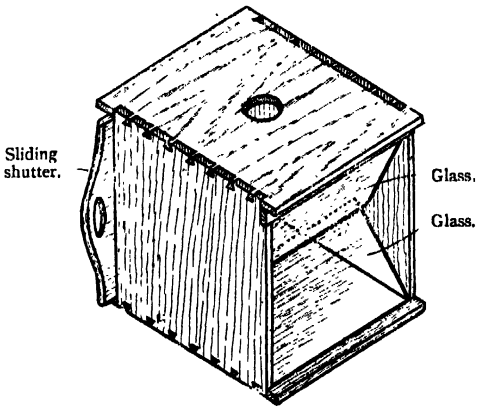


FIG. 88.—MOTH-TRAP.

The Mounting-Boards should be made of yellow pine and cork, glued together.

LESSON 14.

HAMMER-SHAFT.

Drawing. — Prepare working dimensioned sketches for a Hammer-Shaft.

Benchwork.—Work the Hammer-Shaft in accordance with the dimensioned sketches, using ash or hickory.

QUESTIONS.

1. Describe the Ash and its products.

LESSON 4a.

An Overshot Water-Wheel.

The Overshot Water-Wheel requires much less water to produce the same effect than that required for an Undershot Water-Wheel. The water is

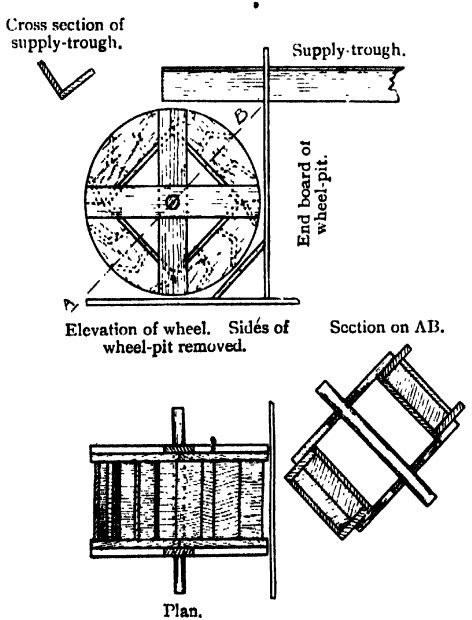


FIG. 89.—OVERSHOT WATER WHEEL.

conducted by a trough to the top of the wheel and falls into bucket-like paddles; the wheel turns in the direction of the descending water. An elevation and plan of the wheel are shown in Fig. 89. The bearings and parts of the wheel-pit are omitted.

Drawing.—Prepare dimensioned drawings of an Overshot Water-Wheel and any other parts necessary to its completion as a working model.

Benchwork. — Construct the Water-Wheel according to your drawings.

LESSON 45.

Letter-Rack.

Design and execute a hanging Letter-Rack, consisting of a back and two or more leaves.

The back is to be formed of several strips of two or more kinds of wood jointed and glued together, and the leaves are to be fretted and secured to the back in such a manner that when not in use they may close on to the back.

Thin sheet-metal may be used in this exercise in addition to the wood required.

It is suggested that the design should be based on the Gothic style.

Questions.

1. State what you know about Teak.

2. Oak has been displaced by Teak in the backing of warships' armour-plates. Why has this been done?

LESSON 45a.

Apparatus for Determination of Intensity of Gravity.

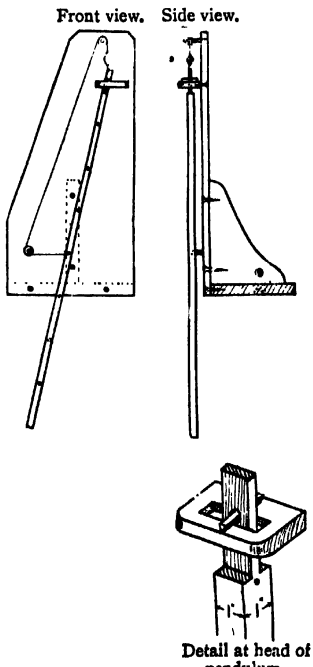


Fig. 90.—Apparatus for Determination of Intensity of Gravity.

This consists of an upright frame of wood, about 3′ high. It is supported by a ledge at the back, so that it can be used on the edge of the bench.

Almost at the top is a platform of hard wood, provided with a slot. The platform is screwed to the support. On this platform the knife-edge of the pendulum rests. The pendulum is a bar of wood about 4′ long and 1″ square. It is cut away at the top, so that it can swing freely in the slot of the platform. Holes at right angles to the plane of oscillation are bored in the pendulum.

A silk thread, to which a double conical bob is attached, is connected with the pendulum, and passes over two light pulleys, as seen above.

Small boxwood pulleys, bushed with glass tubing and pivoted on steel hat-pins with large heads, can be used.

The sharp equator of the bob is smeared with Brunswick black.

LESSON 46.

Bat-and-Ball Trap.

Drawing.—The illustration shows a Bat-and-Ball Trap. Prepare working drawings of the same to a convenient scale.

Benchwork.—Make the stock of the trap from a moderately hard wood, use beech for the trigger, and a long screw for the pivot.

QUESTIONS.

1. What kinds of timber do you consider the most suitable for making the following objects?

Bread-Board, Rolling-Pin, Cricket-Bat, Pantry

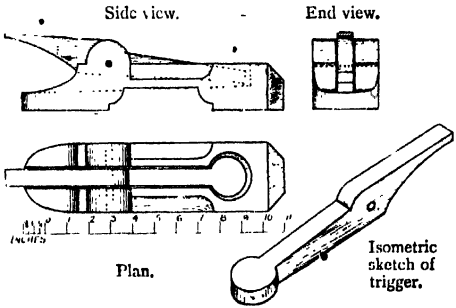


FIG. 91.—BAT-AND-BALL TRAP.

Shelves, Chair, Fence, Archery Bow, Trying-Plane, Cart-Shaft, Flagstaff, Drawing-Board, Rowing-Oars, Tee-Square.

Give reasons for your answer in each case.

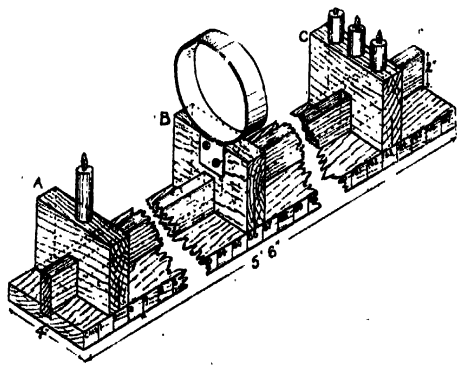
LESSON 46a.

PHOTOMETER.

This consists of a board 5′ 6″ long, 4″ broad, and ¾″ thick. The three carriers, A, B, and C, slide along the centre beam; A and C are bored to carry candles; the centre carrier, B, carries a metal ring, which may be made from a canister-lid; a

second canister-lid rim, with a piece of paper tightly stretched over it, fits inside the first.

Drawing.—Make two elevations and freehand sketches to explain the details sufficiently.



View in isometric projection.

FIG. 92.—PHOTOMETER.

Benchwork.—The model may be executed in Whitewood or Deal.

The groove in the base-board may be worked with a cutting gauge, chisel, and router, should a plough not be available.

LESSON 47.

BAT FOR BALL-TRAP.

Design and execute a small bat for use with the Ball-Trap, using some suitable wood, such as willow.

QUESTIONS.

Make sketches of six kinds of common Tree-Leaves to illustrate 'plain,' 'serrated,' and 'lobed' margins, and name each kind correctly.

LESSON 47a.

SONOMETER.

Drawing.—Prepare such drawings or sketches as you consider necessary.

Benchwork.—Fix the board and the box together, and secure to the two supports. At 1″ from one

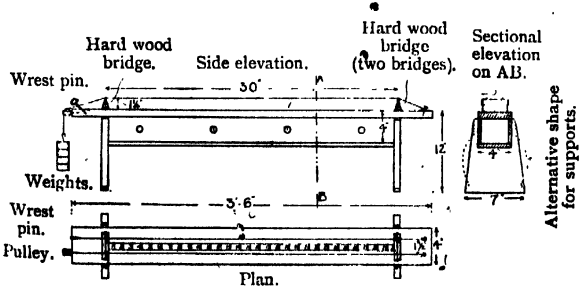


FIG. 93.—SONOMETER.

end of the board make two holes, 1½″ apart, for two iron screws, which must be screwed into the holes until their heads are about ⅛″ above the board. The holes are to be so bored that the heads

of the screws are slightly inclined towards the end of the board. At the other end of the board fix a small pulley and an iron 'wrest-pin,' the latter inclined at an angle of 45°. The pulley is to be near enough to the end of the board to allow a wire passing over it to hang freely, and of such a height that the wire rests upon, but is only just deflected by, the edge of the bridge. The wrest-pin is to fit the hole stiffly, so that it may be turned with a key. Two hard-wood bridges are to be cut, $3'' \times 1\frac{1}{4}'' \times \frac{3}{4}''$; the upper side of each bridge is bevelled to a blunt edge, and along this edge is fixed a stout brass wire for the stretched wires to bear upon.

Glue the bridges in position equidistant from the ends of the board, with the centres of the brass wires exactly 30″ apart. Make a scale between the bridges 30″ long and divided into $\frac{1}{8}''$, and fix it on the board between the bridges.

Twist a loop at the end of a steel or other wire, about 3′ 6″ long, and slip it over the head of one of the screws on the board. Pass the other end through the wrest-pin.

Over the head of the other screw loop a similar piece of wire. Pass the other end of the wire over the pulley, and at the end make a loop from which to hang weights.

Make two movable bridges $\frac{1}{8}''$ higher than those at the end, and face these also with brass wire.

LESSON 18.

BOOK-STAND.

Drawing.—Prepare working drawings of a Book-Stand, adopting dimensions most suitable to your own requirements.

Fig. 94 illustrates the method of construction to be adopted.

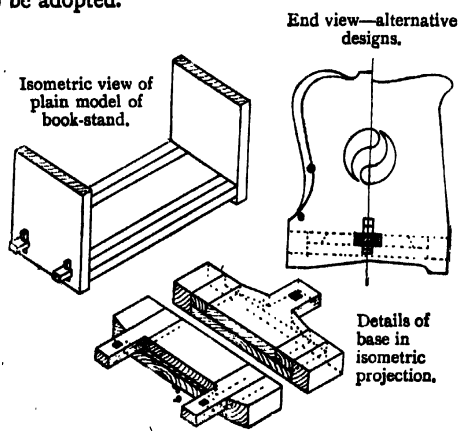


FIG. 94.—BOOK-STAND.

Benchwork.—The upper middle piece of the base is loose, and is connected to one end piece by a keyed tenon, thus allowing the stand to be extended to accommodate more books.

The remaining five pieces of the base may be

made of different coloured woods, jointed and glued together.

Ribbon inlay work may be appropriately used

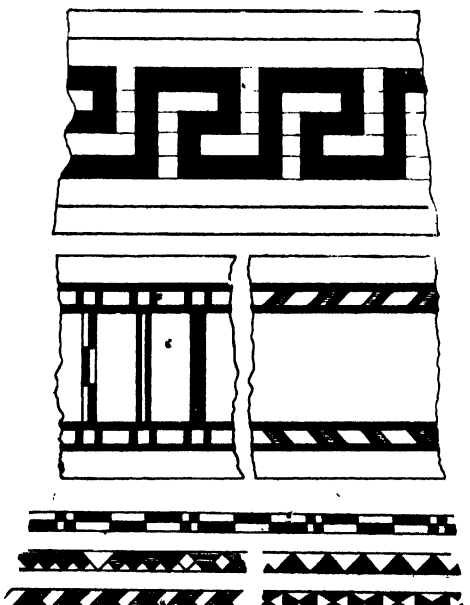


FIG. 95.—BOOK-STAND: SUGGESTIONS FOR INLAY.

for the decoration of the Book-Stand. Some suggestions for this are shown in Fig. 95.

In Fig. 94 are suggested two methods of treating

the ends, but you are to endeavour to produce a design of your own.

QUESTIONS.

1. Make a sketch of a Bow-Saw; name the parts, and state of what material each is made.
2. What mechanical principles are illustrated in the construction of the Bow-Saw?

LESSON 48a.

ELECTRICAL BATTERY.

Drawing.—Make a rough sketch of a Battery, and name the parts.

Benchwork.—The jar may be a fruit-jar, with its top removed by means of a hot wire.

The carbons are those used for street electric lights. Cast two pieces of zinc in a mould. Four carbons, properly insulated from the zinc, but connected by a strip of copper, are clamped on each side of the zinc, two bolts passing through wooden side pieces binding the parts together.

The solution is composed of 12 parts (by weight) bichromate of potash, 25 parts sulphuric acid, 100 parts of water. After the bichromate has dissolved in the water, mix in the acid slowly.

The batteries should be removed from the solution when not in use.

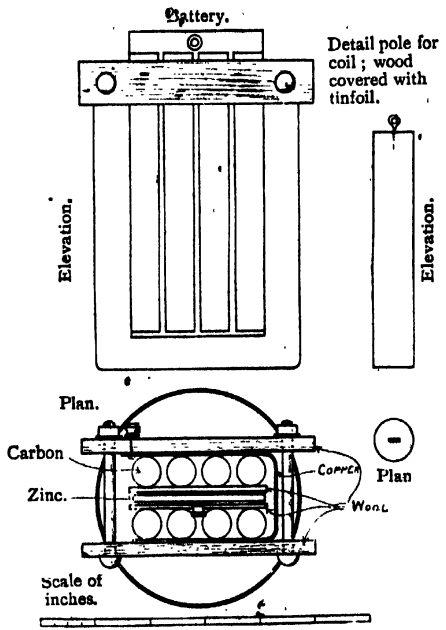


FIG. 96.—ELECTRICAL BATTERY.

LESSON 49.

BRUSH-BRACKET AND MIRROR-FRAME.

Drawing. — The principles of construction involved in making the bracket are shown in Figs. 97 to 98.

Make working drawings, adopting whatever sizes and decorative treatment you consider best.

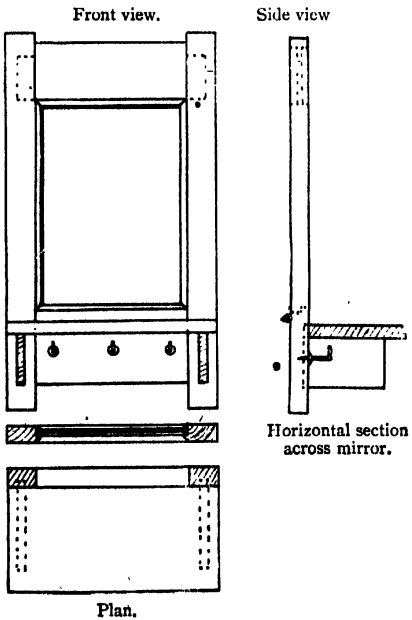


FIG. 97.—BRUSH-BRACKET AND MIRROR-FRAME.

Benchwork.—Suggest a suitable material, and execute the bracket in accordance with your drawings.

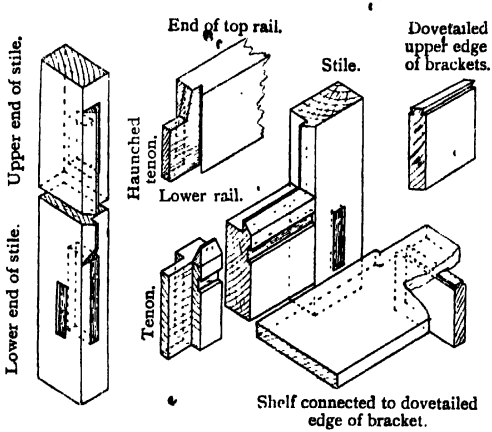


FIG. 98.—BRUSH-BRACKET AND MIRROR-FRAME.
Details of jointing.

QUESTIONS.

Describe the Birch-Tree and its products.

LESSON 49a.

SCALE-BOARD FOR USE WITH REFLECTING GALVANOMETER.

Drawing.—Make a dimensioned sketch of the Scale-Board.

Benchwork.—Prepare the three pieces of wood; screw the base and upright pieces together, and hinge the cover piece to the upright piece.

Shape a piece of brass as shown, fix it, and use

a binding-screw, so that the cover piece may be fixed at any desired angle.

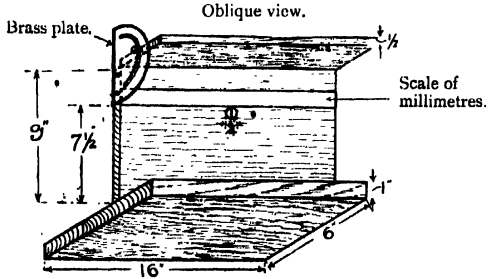


FIG. 99.—SCALE-BOARD FOR USE WITH REFLECTING GALVANOMETER.

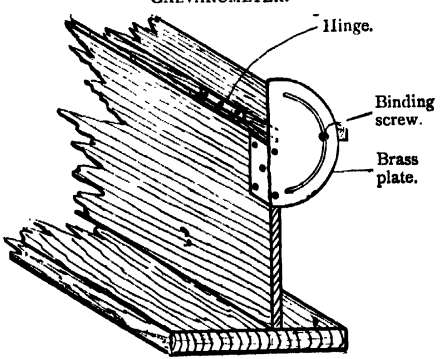


FIG. 100.—SCALE-BOARD FOR USE WITH REFLECTING GALVANOMETER.
Oblique view.

Measure out a scale of millimetres upon a slip of paper, and glue it to the upright board.

LESSON 50.

DWARF-STAND.

Drawing.—Prepare working drawings of the Stand, making whatever modifications you like in

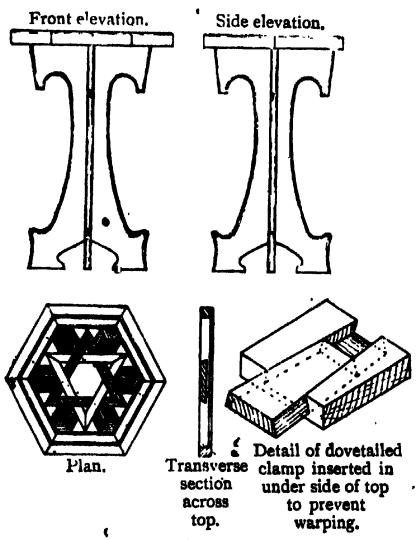


FIG. 101.—DWARF-STAND.

the design, but retaining the same methods of construction.

Benchwork.—Make the Stand to your drawings.

QUESTIONS.

1. Sketch a longitudinal section from nose to heel of the smoothing-plane, giving special attention to the action of the back iron when removing a shaving.

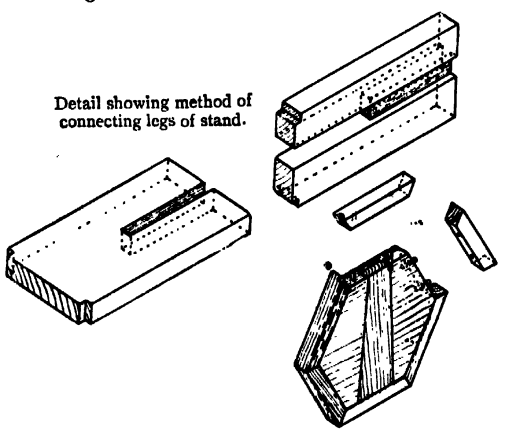


FIG. 102.—DWARF-STAND (DETAILS).

2. Beech planes require 'remouthing' after several years' service. Explain the necessity for this.

LESSON 50a.

TANGENT GALVANOMETER.

Drawing.—Prepare working drawings of the Tangent Galvanometer.

Benchwork.—The two supports are dovetail housed into the base, and the latter has two ledges sunk into its ends; the reel is connected to the supports by wooden dowels.

The reel is wound with No. 20 S.W.G. cotton-

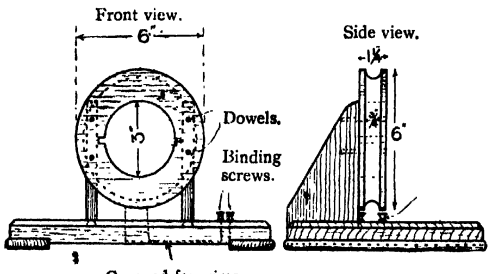


FIG. 103.—TANGENT GALVANOMETER.

covered wire. The inner surface of the reel is so arranged that a box compass 3½" diameter can be fitted into the grooves shown.

The reel may be made from one piece of wood, or it may be built up of two, three, or four layers, glued and dowelled together. If the latter method is adopted, the grain of one piece should be placed at right angles to the grain of the adjacent piece.

LESSON 31.

CHESS-BOARD.

Drawing.—The illustrations shown in Fig. 104 are suggestions for making a Chess-Board.

Adopting the methods of construction there

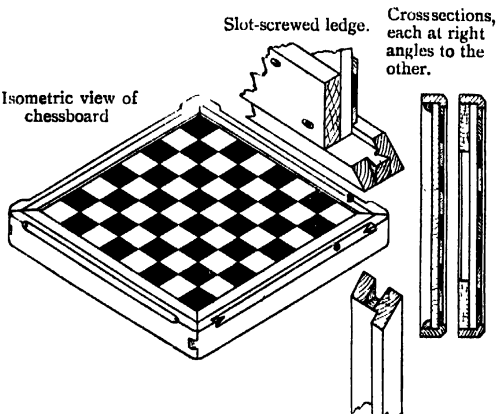


FIG. 104.—CHESS-BOARD.

shown, prepare working drawings in orthographic projection.

Benchwork.—Prepare the base first; glue the marquetry top upon the base, and then frame it.

The base should be made of Yellow Pine or Whitewood, with hard-wood ledges, slot-screwed to it. The marquetry squares may be of any two kinds of wood which will give a pleasing contrast, as White Holly and Ebony or Ebonized Wood, Sycamore and Black Walnut, Birch and Mahogany.

The frame may be of Oak, Mahogany, or Walnut.

QUESTIONS.

Explain the reasons for using:

(*a*) Water with the grindstone;

(*b*) Oil with the oilstone.

How would you 'true up' a grindstone and an oilstone?

LESSON 51a.

MIRROR GALVANOMETER.

Drawing.—Make plan and elevation of the Mirror Galvanometer, and freehand sketches to show clearly all necessary details.

Benchwork.—Prepare the base and pillar, and connect together either by mortise and tenon or dowel jointing.

Make the reel, and fasten to the top of the pillar by means of a small angle piece of brass.

Where a lathe is available, the base, pillar, reel, and plug may be turned.

The wires used to wind round the reel are: No. 28 S.W.G., silk-covered, and No. 20 S.W.G., cotton-covered.

The brass rod to support the directing magnet is $\frac{1}{4}$" diameter.

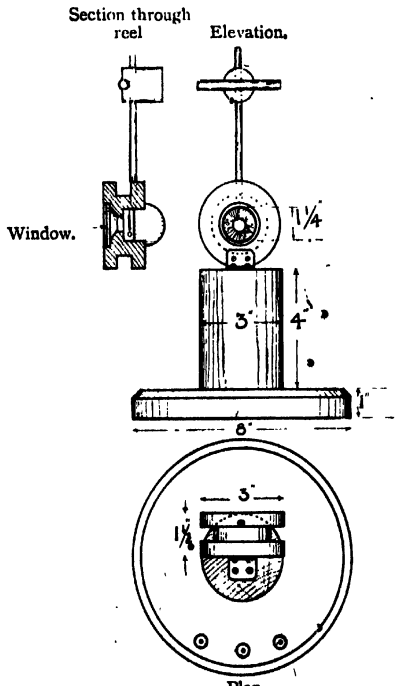


FIG. 105.—MIRROR GALVANOMETER.

LESSON 52.

NEEDLEWORK CABINET.

This model contains four small drawers for holding various sewing requisites.

Above the drawers is a pin-bowl, surrounded by

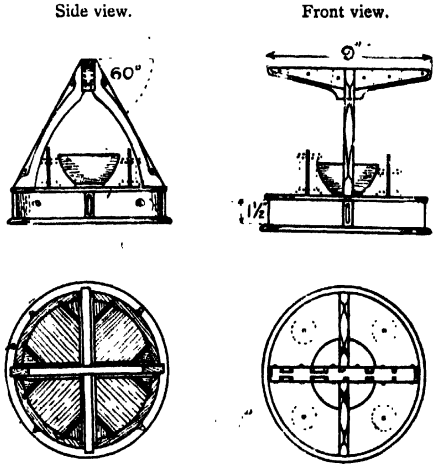


FIG. 106.—NEEDLEWORK CABINET.

metal pins to take reels of cotton or thread. The two arms at the top are notched on both sides to hold scissors, crotchet-hooks, etc., which are kept

in place by pieces of brass or copper-plate screwed to the arms.

The top edge of the arms may be marked in inches for measuring purposes. The length—viz., 9″—is a convenient length, being ¼ yard.

Drawing.—Prepare working drawings and sketch details of the Needlework Cabinet.

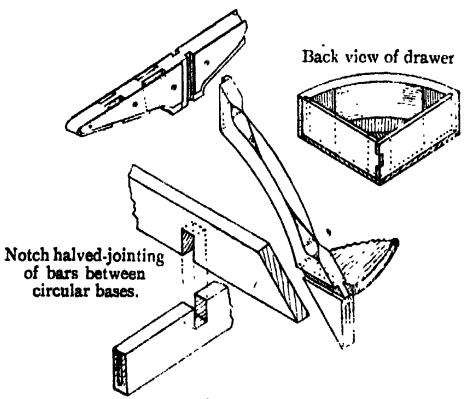


FIG. 107.—NEEDLEWORK CABINET (DETAILS).

Benchwork.—Work the circular base and surbase and screw to the cross-halved intermediate framing; connect the two inclined supports to these, and fit the top arms piece into place. The four pieces of brass or copper-plate, of about $\frac{1}{16}$″ thick, should be shaped with shears and files, drilled for screws, and secured to the arms with

round-headed screws. The pins for the cotton-reels may be made from round wire-nails, the heads of which have been filed off.

The pin-bowl offers scope for a large number of various designs and practice in modelling.

QUESTIONS.

Show several arrangements of saw teeth to a large scale, clearly indicating the angle, set, etc., giving reasons for the differences of arrangement. For what purpose are saws without teeth used? How would you deal with a buckled saw blade? (N.U.T., 1905.)

LESSON 52a.

A SIMPLE ASTATIC GALVANOMETER.

Drawing. — Make necessary working dimensioned sketches.

Benchwork.—Make the base from a piece of white-wood, and give it two or three coats of shellac. Make a copper or brass bridge 7″ high, ½″ wide, $\frac{1}{16}$″ thick. Screw this to the outside of the block, so as to be rigid and firm.

Drill a small hole through the top of the bridge to admit a screw-eye for the suspension of the needles.

Take 10′ or 15′ of No. 30 wire and wind it in coils, and fasten the coils to base-board with small brass or copper straps and copper tacks or screws (do not use iron, steel, or tin).

A short piece of brass or wood will act as carrier for the needles.

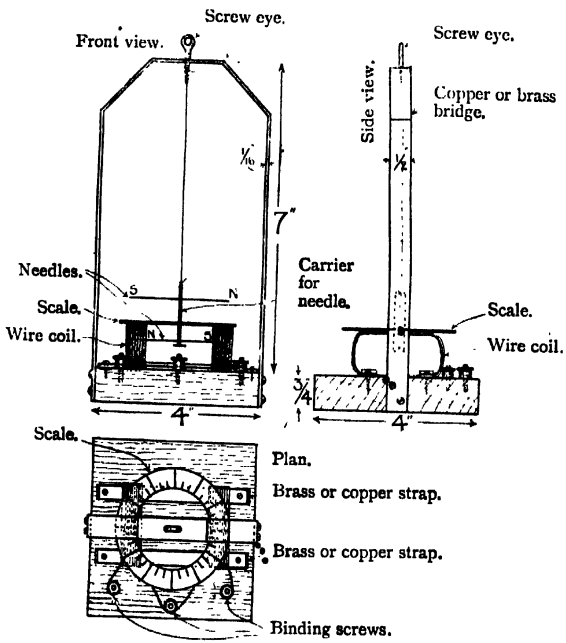


FIG. 108.—SIMPLE ASTATIC GALVANOMETER.

The binding screws are to be arranged as shown in the figure. The circular scale is fixed to the coils by means of paraffin wax.

LESSON 53.

BOOK-SUPPORT.

Drawing.—Draw two elevations and a view of the under side, adding a decorative treatment of the end. Also make a conventional perspective

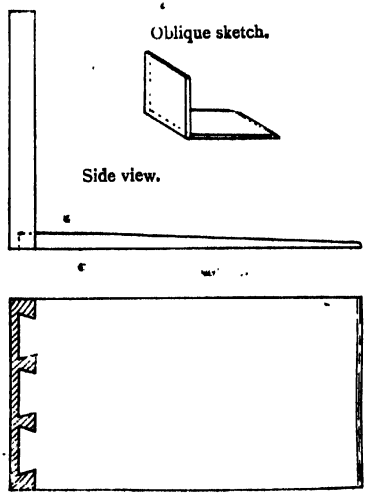


FIG. 109.—BOOK-SUPPORT.

view of the lap dovetail joint to show its construction to the best advantage.

Benchwork.—Make the Book-Support as shown by your drawings.

QUESTIONS

Describe any diseases to which timber is subject:
(*a*). In the tree;
(*b*) After conversion.

LESSON 53a.

INDUCTION COIL FOR TELEPHONE.

The wooden spool is to be turned from a piece of wood $3\frac{1}{2}'' \times 1''$ square. The core-sheath is turned down so that it is about $\frac{1}{16}''$ thick; it is covered

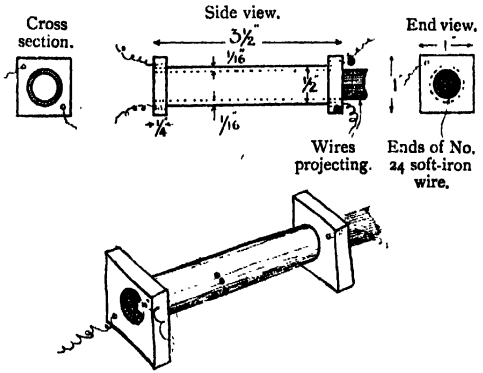


FIG. 110.—INDUCTION COIL FOR TELEPHONE.

with a coat or two of shellac, and two holes are made at each end. The wire is wound by apparatus made in Exercise 58a. The primary winding

is made up of two layers of No. 20 double-insulated copper wire, one end projecting from the hole at one end of the spool and the other from the hole at the other end. Two or three coats of shellac are then given to this coil, and over the layer a piece of paper is wrapped and covered with shellac. The secondary coil is made up of twelve layers of No. 34 silk-insulated wire, and over each layer a sheet of paper is wound to make two wraps, each being given a coat of shellac. When the winding is complete, three or four wraps of paper are added, the whole being covered with shellac. It is then screwed fast in a box. The core-hole within the coil is packed with lengths of No. 24 soft iron wire $3\frac{1}{2}''$ long.

LESSON 54.

SHAVING-CABINET.

The door of the cupboard has a mirror fitted against the inner side of the panel, for use when the door is open. A falling shelf, pivoted to the sides of the cupboard, affords support for shaving-pot, brushes, etc. There are also a small drawer, and a towel-rail, and two hooks for razor-strops are provided.

Drawing.—Prepare working drawings of the Shaving-Cabinet, making any modifications you consider best.

Benchwork.—Prepare and fit together the framework of the Shaving-Cabinet.

The door is to be haunched, mortised, and tenoned together, and rebated to receive panel and mirror, the latter to be secured with beads. The

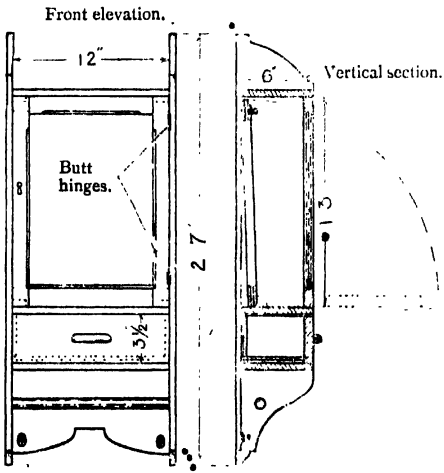
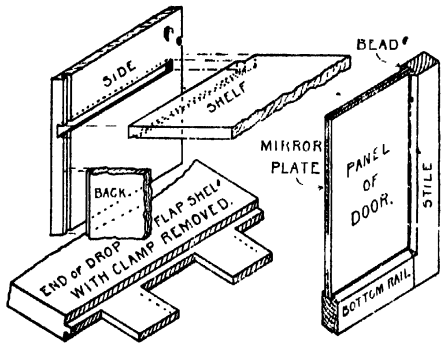


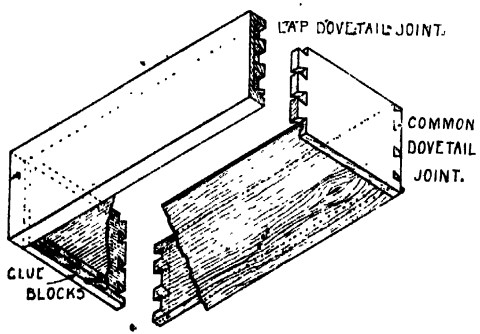
FIG. 111.—SHAVING-CABINET.

drop shelf is to have both ends clamped with mortise and tenon joints.

The sides, front, and back of the drawer are to be dovetailed together, the bottom mulleted into grooves and glue-blocked, and a drawer-pull of wood modelled and screwed from the inside.



Details of jointing.



Detail of drawer in isometric projection.

FIG. 112.—SHAVING-CABINET (DETAILS).

QUESTIONS.

1. Describe what qualities should guide you in the selection of timber.

LESSON 54a.

TRANSMITTER OF TELEPHONE.

Block A may be made of pine, white-wood, or birch, $2\frac{3}{4}''$ square and $\frac{3}{4}''$ thick. A hole $\frac{7}{8}''$ in diameter and $\frac{1}{2}''$ deep is bored in the centre of the block, and a path is cut in the face of the block $1\frac{1}{2}''$ diameter and $\frac{1}{8}''$ deep.

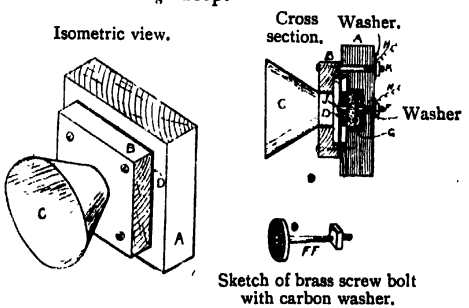


FIG. 113.—TRANSMITTER OF TELEPHONE.

A Wood block back; B, face plate; C, mouth-piece; D, diaphragm of ferrotype plate; FF, carbon washer with brass screw and nut; G, felt or flannel; H, insulated copper wire; J, rivet securing diaphragm to carbon washer; K, fine bolt.

B face-plate is 2″ square, with a $\frac{3}{4}''$ hole in it, and the under side is cut away to a depth of $\frac{1}{8}''$ and a diameter of $1\frac{1}{2}''$. This allows space for the diaphragm D to vibrate when the sound of the voice falls on it, through mouthpiece C.

From carbon $\frac{1}{8}''$ thick two round buttons are

cut, measuring ¾″ across. A small hole is bored in the centre of each button, and one of them is provided with a very small brass screw and nut, shown apart as FF. One side of the buttonhole is countersunk, so that the head of the screw will fit down into it and be flush with the face of the carbon. Cut the surface of the buttons criss-crosswise with a three-cornered file. When mounted in the receiver, the surfaces of the buttons face each other. Cut a small washer of felt or flannel and place it in the bottom of the hole in block A. Line the side of the hole with a narrow strip of the same material; then place the button in the hole, pass the screw through the button and through A, and make it fast with nut. Place a thin flat washer under the nut, and twist a fine piece of insulated copper wire for connections. Solder all joints whenever practicable.

From very thin ferrotype plate cut a piece 2″ square; at its middle attach the other carbon button by means of a small rivet, which can be made from a piece of copper wire; or a small brass machine screw may be passed through the button and plate. Gently tap to rivet it fast, as shown at J. Lay the block down flat and partly fill the cavity with powdered charcoal until the bottom is covered. Do not fill up to the top of the hole. Over this lay disc D, so that the carbon button on the under side fits into the top part of the hole and its felt lining. Fasten the disc to A with small pins. A fine bolt (K) is passed through the

block and disc, and is provided with a nut and washer similar to that at F for connection. Scrape the japan or lacquer from D where the bolt-head touches it. C is a small tin funnel fastened to B. B is screwed fast to A.

LESSON 55.

GONG-STAND.

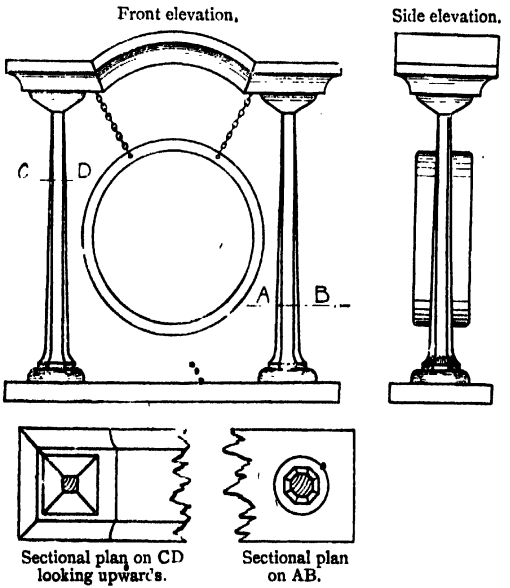


FIG. 114.—GONG-STAND.

Drawing.—Make working drawings of the Gong-Stand to suitable dimensions.

Benchwork.—Work the top from one piece of wood. Each of the pillars is to be worked in three pieces, dowelled together; the dowels are to protrude beyond the length of the pillars, and to connect the pillars to the top and base.

QUESTIONS.

What are the characteristic differences in the structure between the inner and outer portions of the annular rings of the elm? Trace the causes of the differences. (C. and G., 1894.)

LESSON 55a.

RECEIVER OF TELEPHONE.

The tube A is made from a piece of curtain-pole $1\frac{1}{8}$" diameter and $3\frac{1}{2}$" long. A hole $\frac{3}{8}$" diameter is bored through its entire length, and through this hole the magnet passes.

At one end of the tube a wooden pill-box (C) is made fast with glue, or a wooden cup may be turned on a lathe and attached to the magnet tube.

If a pill-box be used, it must be $2\frac{1}{2}$" in diameter, and at four equidistant places inside the box small lugs of wood (D) are to be glued fast. Into these lugs the screws employed to hold the cap are driven.

The cap E is made of thin wood, fibre, or hard rubber. It is provided with a thin rim or collar to separate its inner side from the face of the disc K, which is made of very thin iron. Four small holes are bored near the edge of this cap, so that the screws which hold it fast to cup C may pass through them. The magnet B is a piece of hard steel $\frac{3}{8}$" in diameter and $4\frac{1}{4}$" long.

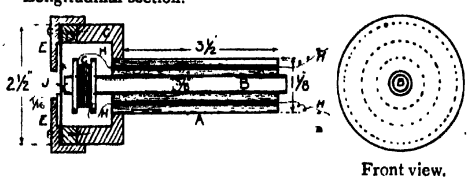


FIG. 115.—RECEIVER OF TELEPHONE.

A, Wooden tube; B, magnet (hard steel) $\frac{3}{8}$" diameter; C, pil box $2\frac{1}{4}$" diameter; D, wood lugs; E, wood cap; F, thin iron disc; G, turned spool wound with No. 36 copper wire; H, thicker wires; J, hole.

Now have a thin, flat spool, turned from maple or boxwood, to fit over one end of the rod, and wind it with a number of layers of No. 36 copper wire.

Drop a little hot paraffin on the wire when it is in place, so that it will not unwind. The ends are fastened to thicker wires running through small holes in the tube A, and projecting at the end as shown.

The magnet is pushed through the hole in A

until the top end of the rod is slightly below the edges of the cup E, so that when the metal disc D is laid over the cup F, the space between the magnet and the disc D is $\frac{1}{16}$". Put a little shellac on the magnet, so that when in its right place it will be held fast.

LESSON 56.

TRAY.

Drawing.—The illustrations in Fig. 116 are given as suggestions for the production of a Tray.

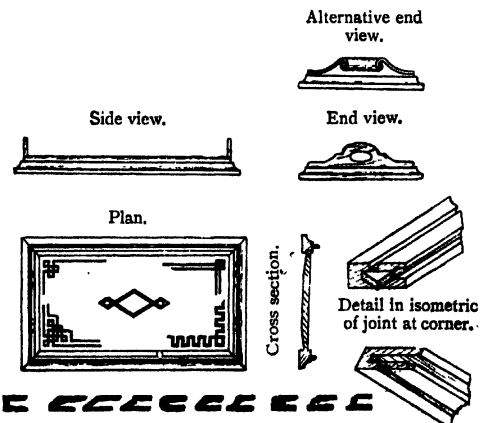


FIG. 116.—INLAID TRAY.

Prepare designs and working drawings for an Inlaid Tray, to be constructed as follows:

The panel is to have an inlaid border and centre, and to be enclosed in a raised framing, the latter to have mitred, mortised, and tenoned joints.

Benchwork.—Make the tray in accordance with your drawings.

QUESTIONS.

1. Draw illustrations of several common forms of 'mouldings,' giving each its respective name.
2. What are the distinguishing features of Roman and Grecian 'mouldings'?

LESSON 56a.

INDUCTION COIL.

Explanation.—The base is of soft pine. The binding-posts (AA) are shown in the drawing as passing through the board, so that the connections shown by dotted lines may be placed in grooves, cut on the under side. These binding-posts can be bought; or brass end-fasteners from sash curtain-rods can be used as substitutes.

The current-breaker (C) is cut from a piece of soft tin. One end is soldered to a piece of soft iron (D), and the other to the head of a machine screw (E).

The ends of the spool for the coil are of thin white-wood. Besides the holes for the core, there

are two small holes in each end through which the current-wire makes entrance and exit. These end-pieces are fastened to the ends of a hollow paper cylinder by means of glue. This cylinder (G) is made of layers of coarse wrapping-paper, cut to a length and wrapped around a lead-pencil, and pasted so as to make it stiff and strong. The

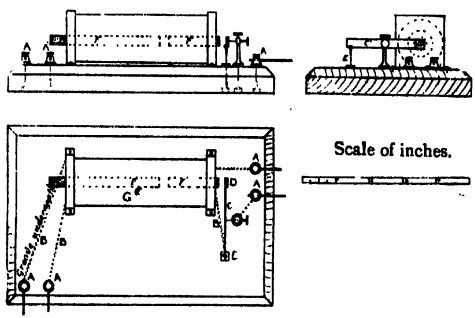


FIG. 117.—INDUCTION COIL.

AA, Binding posts; BBB, grooves underneath in which are placed connecting wires.

primary coil is wound with No. 12 induction wire, the ends extending through the wooden end-piece. A layer of paper is wrapped round this coil before a secondary coil of No. 40 induction wire is wound. A piece of brown paper is wrapped about every second layer of the secondary coil. The secondary coil, after being wound, is neatly covered with brown paper, pasted in place before the coil is

fastened to the base. The poles are made by cutting two cylinders off a broomstick to a length of 4". A brass screw-eye is fastened in one end of each cylinder, to which the wires are attached. The cylinders are covered with tinfoil, which is also wrapped around the brass screw. The lathe (Exercise 58a) is used in the winding of the coils. The core is of soft iron in two parts (FF), in order that the strength of the current may be regulated thereby.

LESSON 57.

CRUMB-TRAY.

Drawing.—Prepare working drawings for a Crumb-Tray, and make a floral design for the

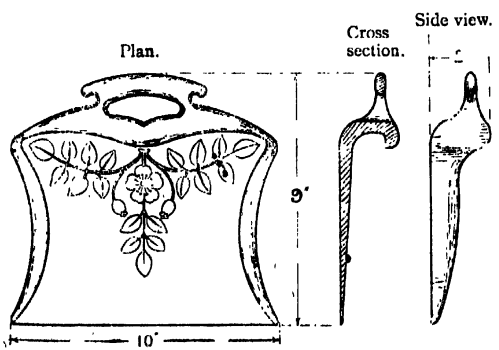


FIG. 118.—CRUMB-TRAY.

blade of the tray which shall be suitable for inlaying.

Benchwork.—Execute the Crumb-Tray and inlay the floral design.

Questions.

Define the term 'seasoning,' as used in reference to the preparation of timber, and explain clearly the reason for the process. State the advantages and disadvantages of artificial seasoning, and briefly describe the chief chemical processes employed in preserving timber from the effects of variable climatic conditions, the attacks of insects, etc. (C. and G., 1907.)

LESSON 57a.

An Electric Bell.

Drawing.—Make a dimensioned working sketch of the model.

Benchwork.—Collect together the parts; fit and fix together as shown in your sketch.

Explanation.—BB are binding-screws; CC the wooden reels, wound with coils of fine insulated wire (No. 12). D is of soft iron, bent round and passing through the reels. E is the wooden keeper, holding CC and D in place. R is the top of a bicycle bell. The striker (G) is a metal bullet soldered to the bent arm attached to J, which is

the armature of soft iron. H is a piece of watch-spring soldered to J and the angle piece M. L is

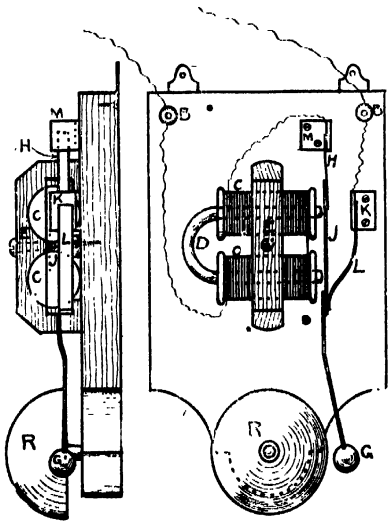


FIG. 119.—AN ELECTRIC BELL.

BB, Binding-screws; CC, wooden reels wound with coils of fine insulated wire; D, soft iron bent round and passing through reels; E, wooden keeper holding CC and D in place; R, bicycle bell top; G, metal bullet soldered to metal striker secured to J; J, armature of soft iron; H, piece of watch spring soldered to J and angle piece M; L, spring soldered to angle piece K; K and M, metal angle pieces.

a bent spring attached to K and just touching J. K is a metal angle piece.

LESSON 58.

DROP-LEAF TABLE.

Drawing.—Prepare working drawings of a Table similar in construction to that illustrated in Fig. 120. Make freehand sketches of the joints.

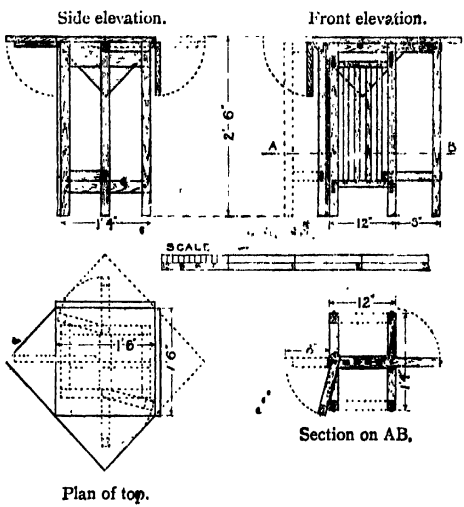


FIG. 120.—DROP-LEAF TABLE.

Woodwork.—Execute the Table in oak, and when it is completed fume and wax-polish it.

LESSON 58a.

WINDING MACHINE FOR ELECTRICAL REELS, ETC.

This machine, though specially suited for winding electrical reels of varying lengths, may be used for several other purposes—viz., (1) for winding twine; (2) as a windlass for hoisting purposes, or for kite-flying. In the latter case it would need

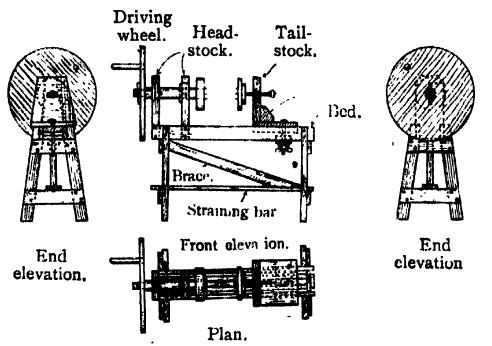


FIG. 121.—WINDING MACHINE FOR ELECTRICAL REELS.

anchoring down to the ground. By a little alteration it could be adapted to other purposes.

Drawing.—Prepare working drawings of the Winding Machine.

No dimensions are given, as these, as well as any necessary structural alterations, depend on the several purposes for which the machine may be used.

Benchwork.—Make the Winding Machine to accord with your drawings.

LESSON 59.

CHAIR.

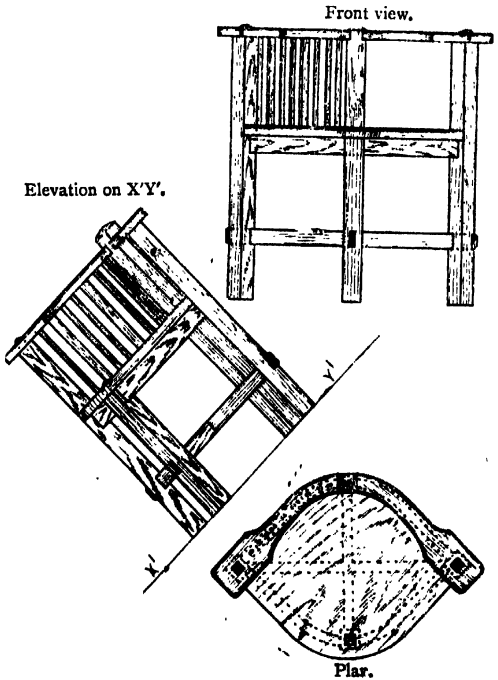


FIG. 122.—CHAIR.

Make designs and working drawings for a Chair to harmonize with the Table in Lesson 58. Some idea of a Chair of the nature required is shown in Fig. 122.

Make the Chair in oak, and fume and wax-polish it.

LESSON 59a.

ORIGINAL SCIENTIFIC MODEL.

Work out, by notes, sketches, drawings, and by a model in material, some application of a Scientific Principle in which you are interested.

LESSON 60.

ORIGINAL MODEL.

Collect together from books, drawings, or actual examples, all the information you can upon one of the following or similar subjects. Illustrate your data by sketches or working drawings, and make a complete model of the subject.

1. The construction and working of railway signals, by day and night.
2. The construction of railroad tracks, points, platforms, etc.
3. The construction of a tube railway.
4. The construction of a railway carriage, waggon, automobile, or other vehicle.
5. The construction and working of canal locks.
6. The history and construction of printing-presses, type, blocks, etc.

7. The construction and working of cranes—jib, derrick, travelling, etc.

8. The construction of some piece of building construction—*e.g.*, floor, roof, door, window, stair, trusses.

9. The construction and working of a lift.

10. The construction of a windmill.

11. The construction of bridges.

12. Pile-driving.

13. Piers.

14. Ships and boats.

15. Workshop, with power.

16. Pumps.

17. Furniture (domestic or office).

18. Stables and their fittings.

19. Toys and games.

20. Photography and its accessories.

21. Optical lantern and its accessories.

22. Pattern making and moulding.

23. Gates, stiles, and fencing.

24. Farm implements and machinery.

25. Farm buildings.

25. Horticultural buildings and implements.

27. Railway turn-table.

28. Construction and flying of kites, balloons, parachutes, etc.

29. A colliery.

30. Musical instruments, etc.

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